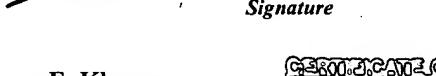


AMENDMENT TRANSMITTAL LETTER (Large Entity) Applicant(s): Ami El Agizy, et al.					Docket No. 9999
Serial No. 09/287,904		Filing Date April 6, 2001	Examiner Raymond Alejandro	Group Art Unit 1745	
Invention: Injection Molded Fuel Cell Endplate					
<i>RECEIVED MAY 13 2003 GROUP 1700</i>					
<u>TO THE ASSISTANT COMMISSIONER FOR PATENTS:</u>					
Transmitted herewith is an amendment in the above-identified application. The fee has been calculated and is transmitted as shown below.					
CLAIMS AS AMENDED					
	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST # PREV. PAID FOR	NUMBER EXTRA CLAIMS PRESENT	RATE	ADDITIONAL FEE
TOTAL CLAIMS	17 -	18 =	0	x \$18.00	\$0.00
INDEP. CLAIMS	2 -	3 =	0	x \$84.00	\$0.00
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>					\$0.00
TOTAL ADDITIONAL FEE FOR THIS AMENDMENT					\$0.00
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of: Ami El Agizy, et al.

Serial No.: 09/827,904

Group Art Unit: 1745

Filed: April 6, 2001

Examiner: Raymond Alejandro

For: Injection Molded Fuel Cell Endplate

**Mail Stop Non-Fee Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450**

AMENDMENT

Sir:

Responsive to the Office Action of February 10, 2003, please amend the application as follows:

Please cancel claim 5 without prejudice.

Please amend claims 1, 3, 6, 8, 11, 13, and 16 to 18 to read as follows:

1 (amended) A molded fuel cell endplate fabricated from a long fiber reinforced thermoplastic resin composite, which composite comprises:

(a) a thermoplastic resin comprising a thermoplastic polymer selected from the group consisting of partially aromatic polyamides, polyarylsulfones, polyaryletherketones,

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By:

Monica Y. Pettus
Monica Y. Pettus

Date:

5/9/03

Abd

polyaryletheretherketones, polyaryletherimides, polyarylimides, polyarylene sulfide, and aromatic thermotropic liquid crystal polymers; and

(b) at least about 30 weight percent of long strand glass fiber at least about 5mm in length.

AB

3 (amended) A fuel cell endplate as described in claim 2 wherein said composite contains from 40 to 60 weight percent of said long strand glass fiber.

AB

6 (amended) A fuel cell endplate as described in claim 3 wherein said long strand glass fiber is from about 15 micron to about 20 micron in diameter.

AB

8 (amended) A fuel cell endplate as described in claim 3 wherein said composite contains at least 50 weight percent of said long strand glass fiber.

AB

11 (amended) A fuel cell endplate as described in claim 2 which is fabricated as a single injection molded part.

AB

13 (amended) A fuel cell endplate as described in claim 3 wherein said composite has a calculated resistance of less than 1.6.

AB

16 (amended) A fuel cell endplate assembly comprising a fuel cell endplate as described in claim 3.

AB

17 (amended) A fuel cell endplate assembly as described in claim 16 wherein the endplate functions as a compression plate and the assembly lacks a separate compression plate.

18 (amended) A fuel cell endplate assembly as described in claim 17 wherein the endplate is fabricated as a single molded part.

Regarding the objection to the Drawings, component 16 of Figure 1 is described at page 4, lines 1 to 2 of the subject application. Accordingly, it is respectfully submitted that this objection is improper and should be removed.

Claim 1 has been amended to identify the thermoplastic resin component (a) as comprising those polymers listed in original claim 5, from which list the phrase "and the like" has been deleted. It is respectfully submitted that this amendment overcomes the objection set forth in Paragraphs 3 to 5 of the Office Action of February 10, 2003, and the rejection of the claims under 35 U.S.C. 112 as indefinite.

Claim 1 has been further amended to delete the second period and rewrite the term "end plate" as a single word. Claims 6, 8, 11, 13, 16 and 17 have been amended to change their dependency and/or to rewrite the term "end plate" as a single word. Claims 3 and 8 have been further amended to delete the word "about". Claim 17 has been further amended to incorporate the requirements of claim 18. Claim 18 has been amended to further describe the endplate as being fabricated as a single injection molded part; support for this amendment is provided in the specification at page 6, lines 27 to 30.

Claims 1 to 4, 10 to 13, and 15 stand rejected under 35 U.S.C. 102(a) as unpatentable over US 6,248,467 to Wilson et al. ("Wilson") in view of U.S. 6,048,835 to Guthrie ("Guthrie"). Claims 5 to 9, 14, and 16 to 18 stand rejected under 35 U.S.C. 103(a) as unpatentable over Wilson in view of Guthrie and further in view of U.S. 6,200,698 to Carlstrom, Jr. ("Carlstrom").

As amended, the subject application claims a molded fuel cell endplate fabricated from a long fiber reinforced thermoplastic resin composite which composite comprises (a) a thermoplastic polymer selected from a specific group of materials (which group includes polyphenylene sulfide (PPS) and liquid crystal polymers (LCPs)) and (b) a relatively

high loading of long strand glass fiber at least about 5 mm in length, as well as endplate assemblies comprising such a plate. Depending upon the claim, the composite comprises long glass fiber in an amount of at least about 30 weight percent, from 40 to 60 weight percent, from about 45 to about 55 weight percent, or at least 50 weight percent.

Wilson discloses a bipolar separator plate for electrochemical cells, which plate is molded from a thermosetting vinyl ester resin matrix containing a conductive powdered material. At column 4, lines 44 to 60, Wilson discloses the following regarding the conductive powdered material used in the separator plate therein disclosed:

A conductive powder, preferably graphite, of a range of particle sizes predominantly between 80 and 325 mesh, is added to the formulated resin to impart electrical conductivity to the composite. While the preferred embodiments utilize graphite as the conductive powder component of the material, it can be appreciated that conductive particles or powders other than graphite (e.g. metals, boron carbide, titanium nitride) may also be suitable for these composites. However, graphite has the advantages of low cost, low weight, ready availability, and chemical stability for this application.

A percolated (connected) network of conductive particles must be formed to produce an electrically conductive composite. Graphite typically percolates around 20 volume percent in a binary system, but carbon black can percolate at concentrations of less than one volume percent. Thus it may be beneficial to add small amounts (up to about 5 weight percent) of carbon black to effectively increase the number of electrical contacts between the conducting particles. Carbon black may also be useful for controlling compound rheology due to its high surface area.

An upper limit on the amount of graphite particles is determined by the need to provide enough resin to maintain plate integrity. This upper limit is about 95% graphite by weight. Thus, depending on the particular fuel cell design, the graphite particle loading should be between 20-95% by weight.

In electrochemical cells, current is generated by a series of individual cells that are connected in series to form a fuel cell stack. In the stack, bipolar separator plates separate the individual cells. A primary function of the bipolar separator plate is to collect current. Endplate assemblies, operating in conjunction with a connecting means, for example, tie rods or bands, exert a compressive force on the stack that assists in holding the stack together.

The bipolar separator plates disclosed by Wilson are vastly different, in form as well as function, from the endplates claimed by the subject invention. True to their purpose of conducting current, the separator plates of Wilson are comprised of a thermosetting matrix resin that contains a relatively high loading of a powdered conductive filler, preferably graphite. That filler provides a conductive network that enables the plate to collect current. In contrast, the endplates of the subject invention are formed from a composite comprising a specific thermoplastic resin and a relatively high loading of glass, in the form of long strand glass fibers.

The glass fiber reinforced thermoplastic composite from which the subject endplates are formed does not have the conductivity of the graphite filled thermoset that is used to form the separator plate of Wilson. The composite used in the endplate of the subject invention does, however, provide the endplate with strength as well as creep and warp resistance.

As demonstrated by the data included in the subject application, creep and warp resistance of a composite depend on factors that include the form of the glass component. Molded test specimens made from a pultruded PPS composite containing

40 weight percent of glass fiber 11 mm in length and 17 microns in diameter was shown to be significantly more resistant to flexural creep than a PPS composite containing 40 weight percent of glass fiber 1 mm in length and 13 microns in diameter, which composite was prepared by melt compounding. Compare the data for Samples 2 and 3. That is to say, the form of the glass component of the subject composite, is a critical factor of the subject invention, which requires the use of composites comprising fiber at least about 5 mm in length. Fuel cell endplates fabricated from a long fiber reinforced thermoplastic composites comprising at least 30 weight percent of glass fibers at least about 5 mm in length are not disclosed or suggested by Wilson which is directed to separator plates formed from a thermosetting composite comprising relatively high loadings of graphite powder.

It is noted that Wilson does include a disclosure of fiber reinforcement, however such fiber relates to short as opposed to long fiber, and the disclosure includes a description of the problems associated with incorporation of such materials in the powder composites.

Conventional composites are typically fiber reinforced to provide additional strength and/or flexibility. Traditional fiber reinforcements for structural composites include graphite, glass, Kevlar, and metal. The fibers are typically used as is but may have surface treatments designed to improve fiber-resin adhesion.... In general, these high-strength fibers impart vastly improved mechanical properties in structural composites where long fibers or fabric rovings are used and the volume fractions of resin are typically quite high (e.g., 60% or more). In the case of electrically conductive composites for electrochemical applications, any fiber reinforcements that are used need to be relatively short to attain good fill, avoid hand lay-up, and provide a relatively homogenous structure. As a result, short "microfibers" (<1mm) are utilized. On the other hand, the volume fractions of resin and fiber in the conductive composite must be considerably lower to accommodate the conductive powder component. As

such, it is difficult for resin to sufficiently encapsulate or adhere to the fibers to effectively utilize the superior mechanical properties of the fibers. See column 4, line 61 to column 5 line 15. Emphasis added.

Wilson goes on to identify cotton flock as its fiber of choice.

At the bottom of page 3 to the top of page 4, the Office Action appears to equate this disclosure of the use of short (<1mm) microfibers as reading on the use of long strand glass fiber at least about 5mm in length. It is respectfully submitted that even with the use of the word "about", the term "long strand glass fiber at least about 5mm in length" would not be understood by one skilled in the art as reading on short microfibers <1mm in length. Moreover, interpreting the claim phrase "long strand glass fiber at least about 5mm in length as reading on fibers <1mm in length is inconsistent with the distinction made by Applicants between long strand glass fiber and "conventional fiber" and the data provided in the subject application. As noted above, the application contrasts creep data for composites containing long strand glass fiber 11 mm in length with that of a composite containing what is referred to in the Examples as "conventional short glass fiber" 1mm in length. Accordingly, it is submitted that Wilson does not disclose or suggest the use of long strand glass fiber as required by the subject claims.

Guthrie discloses a fuel cell endplate assembly fabricated from a metal pressure plate having a header fabricated from a non-conductive polymeric material. At column 3, beginning at line 61, the composition of the plastic header is described:

Turning next to a more detailed description of FIG.1, the positive end plate assembly 28 includes a header 12 mounted in a notch **28a**, provided for this purpose in the metal conductive positive end plate assembly or elements **27**. The header **12** is fabricated from a different material than that from which these plate elements are made, preferably being fabricated from a polymeric material such as NORYL, a proprietary product of General Electric Company. This

polymeric material preferably has a filler added to the extent of at least 30%. A glass fiber filler is preferred. This polymeric material provides some of the same strength and thermal expansion characteristics of the electrically conductive metal material from which the end plates are fabricated, but affords superior corrosion resistance and lighter weight. Typically, the metal used comprises an aluminum alloy that is plated with nickel to prevent corrosion.

At page 2, lines 15 to 16, the subject application notes that General Electric Company markets modified polyphenylene oxide resins under the NORYL trademarks.

Even if combined, the combination of Wilson and Guthrie does not disclose or suggest either the thermoplastic component (i.e., a thermoplastic resin comprising a thermoplastic polymer selected from the group consisting of partially aromatic polyamides, polyarylsulfones, polyaryletherketones, polyaryletheretherketones, polyaryletherimides, polyarylimides, polyarylene sulfide, and aromatic thermotropic liquid crystal polymers) or the long glass fiber component (at least about 30 weight percent of long strand glass fiber at least about 5mm in length) of the composites from which the instant endplates are formed. As noted above, the fiber length required by the subject claim is a critical parameter of the invention that is neither disclosed nor suggested by Wilson (discussed above) or Guthrie, which is silent on the fiber length of its composite. Additionally, there is nothing in either citation which discloses or suggests a fuel cell endplate fabricated as a single molded part as described by claims 11 and 18, or the endplate assembly as described by claims 17 and 18, wherein the thermoplastic endplate functions as a compression plate, and the assembly lacks a separate compression plate.

Carlstrom is directed to an endplate assembly for use in a fuel cell assembly having a fuel cell stack, said endplate assembly comprising:

a housing having a cavity; and

bladder receivable in the cavity and engageable with the fuel cell stack; wherein the bladder comprises a two-phase fluid having a liquid/vapor phase transition at the operating temperature and pressure of the fuel cell stack.

At column 4, lines 18 to 38 Carlstrom notes:

As best shown in FIGS. 1 and 4, end plate assembly 50 includes a housing 52 having a cavity 54 (FIG. 1) for receiving bladder 60, a seal plate 70, and a plunger 80. Desirably, housing 52 is formed from a plastic material such as RYTON polyphenylene sulfide (PPS), manufactured by Phillips Chemical Company of Bartlesville, Okla., which allows the endplate assembly to be lightweight. Housing 52 may also be made of other suitable materials, as will be appreciated by those of ordinary skill in the art.

Plunger 80 is desirably partially receivable within cavity 54 and includes a first surface 82 (FIG. 4) which engages one end of fuel cell stack 40. Advantageously, housing 52 need not be rigid and thus may flex or bend relative to bladder 60 when compressing fuel cell stack 40. Bladder 60 is desirably fabricated from a rubber or elastomeric material allowing bladder 60 to be flexible and to uniformly distribute clamping forces applied to seal plate 70, plunger 80, and ultimately to, fuel cell stack 40.

While, Carlstrom does disclose the use of PPS in its endplate assembly housing, as is the case with Guthrie, there is nothing in Carlstrom that suggests the criticality of using PPS composites comprising long strand glass fiber at least 5 mm in length as required by the subject claims. Moreover, in Carlstrom the fuel cell stack is compressed by expansion of a flexible bladder that applies a force, against a seal plate that, in turn, engages with a plunger and compresses the stack. Carlstrom does not disclose or suggest an endplate assembly as described by claims 17 and 18 of the subject

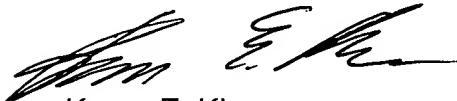
application wherein the endplate functions as a compression plate and the assembly lacks a separate compression plate.

All of the citations applied against the subject claims relate to fuel cells, albeit in different ways. The primary focus of Wilson is on bipolar separator plates, whereas, Guthrie and Carlstrom deal with endplate assemblies of very different designs. There is no motivation for one skilled in the art to apply the teaching of Wilson and its disclosure of conductive bipolar plates to either Guthrie or Carlstrom, each of which is directed to endplate assemblies. As to the combination of Guthrie and Carlstrom, the endplate assemblies of these citations are of very different design; in Guthrie the assembly is a metal pressure plate with a plastic header, whereas, in Carstrom the assembly is a plastic housing with an inflatable bladder. The combination of citations applied against the claims is mere hindsight suggested only by the subject invention. Accordingly, it is respectfully submitted that the combination of Wilson and Guthrie as well as the combination of Wilson, Guthrie and Carlstrom is improper and should be withdrawn.

Moreover, even if combined, it is respectfully submitted that the combination of citations fails to disclose or suggest the subject invention, which requires the use of a long glass fiber reinforced composite comprising a selected thermoplastic and at least about 30 weight percent of long glass fiber at least about 5 mm in length. As demonstrated by the data provided in the application, resistance to creep is affected by the form of the glass fiber component. The criticality of fiber length is not disclosed or suggested by any of the references.

Accordingly, reconsideration and allowance of the subject claims, as amended, is respectfully requested.

Respectfully submitted:



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